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British Standards Institution
Report

**No. 87—1919.**

# British Engineering Standards Association

*(Incorporated 1918.)*

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE
BY
THE INSTITUTION OF CIVIL ENGINEERS.
THE INSTITUTION OF MECHANICAL ENGINEERS.
THE INSTITUTION OF NAVAL ARCHITECTS.
THE IRON AND STEEL INSTITUTE.
THE INSTITUTION OF ELECTRICAL ENGINEERS.

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# REPORT
ON
BRITISH STANDARD DIMENSIONS
FOR
AIRSCREW HUBS.

LONDON:
PUBLISHED FOR THE ASSOCIATION BY CROSBY LOCKWOOD & SON,
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*March, 1919.*

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## PREFACE.

The Sectional Committee on Components of Aircraft and Aircraft Engines was appointed at a meeting of the Main Committee held on July 26th, 1917, and Aircraft Sub-Committee **C** was appointed by the Sectional Committee on August 28th, 1917, to deal with the Standardisation of Airscrew Hubs and their fixing.

Previous to the formation of the Sectional Committee, the Technical Department of the Air Board issued for the guidance of designers a table of standard dimensions affecting the fixing of the airscrew to the hub.

Experience had indicated that the basis of the Air Board Standards was not altogether suitable, and that it was necessary to revise the standard dimensions to meet the requirements for certain types of engines and also for engines of 300 H.P. and over.

During the Inter-Allied Aircraft Standardisation Conference held in London in March, 1918, it was ascertained that the progress of standardisation of airscrew hubs in America, France and Italy was no further advanced than in England, and it appeared possible to obtain international standardisation if early action were taken in connection with the high-powered engines.

The Sub-Committee, after careful consideration of the evidence obtained from engine designers, manufacturers, and also from the delegates to the Inter-Allied Conference, decided to divide the standardisation of airscrew hubs into two parts, viz.:—

(1) Dimensions affecting the fixing of the Airscrew to the Hub,
and (2) Dimensions affecting the fixing of the Hub to the Airscrew Shaft.

It was further decided to deal immediately with Part 1, leaving Part 2 until additional experience of improved methods of fixing had been obtained.

The present Report gives the dimensions affecting the fixing of the airscrew to the hub for engines up to approximately 1,000 H.P., and includes so far as was found desirable the essential dimensions of existing standard hubs, which have been found satisfactory for engines under 200 H.P.

Metric units have been adopted throughout the Report with the exception of the screw threads on the bolts. The Sub-Committee in recommending this policy had before them the advisability of including existing hubs which are mainly in metric units and also the possibility of subsequent International Standardisation.

While a considerable amount of work remains to be done, particularly in connection with the dimensions affecting the fixing of the hub to the airscrew shaft, the Sub-Committee considers that the issue of this Report will help forward international standardisation of airscrew hubs, and at the same time satisfy the immediate need of designers.

This report was approved by the Sectional Committee on Components of Aircraft and Aircraft Engines at their Meeting on 10th January, 1919, and approved on behalf of the Main Committee on 29th January, 1919.

A. A. ROSS,

*Chairman of Aircraft Sub-Committee* **C** *on*
*Airscrew Hubs and their Fixing.*

# REPORT
ON
# BRITISH STANDARD DIMENSIONS
OF
# AIRSCREW HUBS.

## Introductory Remarks.

**1.** This Report has been drawn up with a view of standardising dimensions affecting the interchangeability of airscrews when fitted to the hubs. The problem of the standardisation of the method of fixing the hub to the engine airscrew shaft is still under consideration, but the two following recommendations are made :—

*(a)* The attachment of the hub to the shaft by means of parallel serrations (concentricity being ensured by short cones at each end of the hub) appears to be the most satisfactory method suggested by existing practice for 12-cylinder engines.

*(b)* Where tapered shafts are used, the taper should be 1 in 5 on the diameter of the cone, and the fit of the hub on the shaft should be so arranged that the greatest intensity of pressure is set up on the driving end of the hub, which is generally at the larger bore of the taper.

NOTE.—This may be done by recessing the bore from the smaller end for a length equal to two-thirds of the length of the boss or by making the taper bore in the hub of a smaller angle, such that the small end of the bore is ·002 inch larger than the corresponding portion of the shaft.

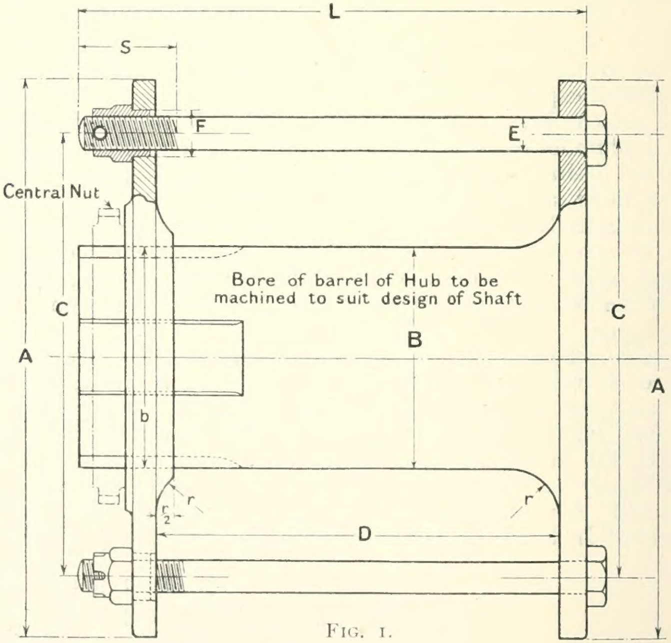
L
S
F
E
Central Nut
C
A
Bore of barrel of Hub to be machined to suit design of Shaft
B
C
A
b
r
r
$\frac{r}{2}$
D

FIG. 1.

NOTE.—*The detailed design of those parts of the hub which are not affected by the dimensions given in Table 1 need not be in strict accordance with that shown in Figure 1.*

### TABLE 1. STANDARD DIMENSIONS.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B.S. No. | BOLTS. | | | | | | A | B | C | D | r | H.P. N. See Appendix I. |
| | Number. | E Diameter. | Thread B.S.F. | L Length. | S Length of Screwing. | F Dia. of Hole in Flange for Nut. | External Dia. of Flanges. | External Dia. of Barrel. | Pitch Circle of Bolt Holes. | Distance between Flanges. | Radius at Flange. | |
| | | mm. | in. | mm. | mm. | mm. | mm. | mm. | mm. | mm. | mm. | From— |
| **1** | 6 | 11 | 7/16 | 160 | 60 | 14 | 150 | 60 | 120 | 110 | 6 | 0 to 0·08 |
| **2** | 8 | 11 | 7/16 | 190 | 60 | 14 | 190 | 70 | 150 | 140 | 6 | 0·08 to 0·15 |
| **3** | 8 | 11 | 7/16 | 220 | 60 | 14 | 220 | 80 | 170 | 170 | 8 | 0·15 to 0·23 |
| **4** | 8 | 15 | 9/16 | 260 | 70 | 18 | 260 | 80 | 200 | 200 | 8 | 0·23 to 0·38 |
| **5** | 10 | 15 | 9/16 | 290 | 70 | 18 | 300 | 90 | 230 | 230 | 10 | 0·38 to 0·58 |
| **6** | 12 | 16 | 5/8 | 335 | 70 | 19 | 330 | 100 | 250 | 270 | 10 | 0·58 to 0·74 |
| **7** | 12 | 16 | 5/8 | 370 | 75 | 19 | 350 | 110 | 270 | 300 | 12 | 0·74 to 0·93 |
| **8** | 12 | 16 | 5/8 | 400 | 75 | 19 | 380 | 115 | 290 | 330 | 12 | 0·93 to 1·16 |

### TABLE 2. STANDARD LIMITS.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B.S. No. | E Dia. of Bolts. | | E and F Dia. of Holes for Bolts and Nuts. | | C Pitch Dia. and Position of Bolt Holes. | B Ext. Dia. of Barrel. | | b Large Dia. of Bore of Loose Flange. | | A External Dia. of Flanges. | | D Distance between Flanges (minimum adjustment). | |
| | Min. | Max. | Min. | Max. | | Min. | Max. | Min. | Max. | Min. | Max. | | |
| | mm. | mm. | mm. | mm. | | mm. | mm. | mm. | mm. | mm. | mm. | mm. | mm. |
| **1** | –·05 | +·05 | +·20 | +·25 | The dimensions between any two bolt holes shall be within ·05 mm. of their nominal position. | –·07 | –·02 | –·02 | +·03 | –0 | +·50 | –12 | +12 |
| **2** | –·05 | +·05 | +·20 | +·25 | | –·07 | –·02 | –·02 | +·03 | –0 | +·50 | –12 | +12 |
| **3** | –·05 | +·05 | +·20 | +·25 | | –·07 | –·02 | –·02 | +·04 | –0 | +·50 | –12 | +12 |
| **4** | –·05 | +·05 | +·20 | +·25 | | –·07 | –·02 | –·02 | +·04 | –0 | +·50 | –12 | +12 |
| **5** | –·05 | +·05 | +·20 | +·25 | | –·07 | –·02 | –·02 | +·04 | –0 | +·50 | –12 | +12 |
| **6** | –·05 | +·05 | +·20 | +·25 | | –·09 | –·04 | –·02 | +·04 | –0 | +·50 | –12 | +12 |
| **7** | –·05 | +·05 | +·20 | +·25 | | –·09 | –·04 | –·02 | +·05 | –0 | +·50 | –12 | +12 |
| **8** | –·05 | +·05 | +·20 | +·25 | | –·09 | –·04 | –·02 | +·05 | –0 | +·50 | –12 | +12 |

A general limit of ± 0·20 mm. will be allowed on all dimensions of the Hub not specified in Table 2.

**Dimensions and Tolerances.**

**2.** The dimensions and tolerances of the hubs shall be in accordance with Tables 1 and 2, and Figure 1. The dimensions not specified are left optional.

### Bolts and Nuts.

**3.** (*a*) All screw threads shall be British Standard Fine sizes; the crest of the threads of the $\frac{7}{16}$ inch bolt will be flattened slightly owing to the diameter of the bolt being slightly smaller than the Standard B.S.F. size.

(*b*) A radius of 0·5 mm. shall be provided under the heads of the bolts.

(*c*) The nuts shall be recessed into the flanges as shown in Figure 1.

(*d*) Provision shall be made for locking the nuts.

(*e*) One row only of bolts shall be used, but a central nut, fitted to the barrel of the hub as shown in Figure 1, may be used if desired, in addition to the single row of bolts of the number and diameter given in Columns 2 and 3 of Table 1.

(*f*) In order to provide an adjustment of ± 12 mm. between the flanges all bolts must be screwed for the lengths given in Col. 6 of Table 1.

### Flanges.

**4.** (*a*) The inner surfaces of the flanges shall be rough finished to increase the frictional surface.

(*b*) A radius shall be provided at the inner face at each flange, where the flange joins the barrel, in accordance with the dimensions given in column 12 of Table 1.

(*c*) The loose or detachable flange shall be a reasonably good fit on the barrel when assembled.

(*d*) The bolt holes in the fixed flange shall be countersunk to suit the 0·5 mm. radius under the heads of the bolts.

## APPENDIX I.

### SIZE OF HUBS.

(*a*) The most suitable size of hub for a particular engine is ascertained by reference to Column 13 of Table 1, which gives the ranges of H.P. divided by N., *i.e.*, the R.P.M. of the Airscrew Shaft for which each hub is suitable.

(*b*) The figures in Column 13 are for 12-cylinder engines and for hubs which transmit the power through one flange only.

(*c*) For engines having special torque characteristics or peculiar methods of power transmission, the figure obtained by dividing the H.P. by the R.P.M. of the Airscrew Shaft must be multiplied by a suitable constant and then referred to Column 13 of Table 1. For 8 cylinder engines it is suggested that a suitable constant for this purpose is 2.

## APPENDIX II.

### BRITISH STANDARD $\frac{7}{16}$, $\frac{9}{16}$ AND $\frac{5}{8}$ INCH FINE THREADS.

#### THEORETICAL DIMENSIONS.

*Extracted from Table I., Report No. 84—1918.*

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Nom. Dia. of Screw. | No. of Threads per inch. | Pitch. | Depth of Thread. | Full Diameter. | | Effective Diameter. | | Core Diameter. | | Cross-sectional Area at Bottom of Thread of Bolt. |
| | | | | Bolt. | Nut. | Bolt. | Nut. | Bolt. | Nut. | |
| In. | | In. | In. | In. | In. | In. | In. | In. | In. | Sq. In. |
| $\frac{7}{16}$ | 18 | ·05556 | ·03555 | ·4375 | ·4395 | ·4019 | ·4039 | ·3664 | ·3684 | ·1054 |
| $\frac{9}{16}$ | 16 | ·06250 | ·04000 | ·5625 | ·5645 | ·5225 | ·5245 | ·4825 | ·4845 | ·1828 |
| $\frac{5}{8}$ | 14 | ·07143 | ·04575 | ·6250 | ·6270 | ·5793 | ·5813 | ·5335 | ·5355 | ·2235 |

For Standard Sizes and Tolerances (Close Fits) see Tables IV. and V. of Report No. 84—1918.

# British Engineering Standards Association.

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MARCH, 1919.

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